PATENT APPLICATION

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

In re application of J. DAVIOT *et al*

Docket No: 060937-0172-US

Appln. No.: 10/688,900

Group Art Unit: 1765

Confirmation No.: 3765

Examiner: Shamin AHMED

Filed: October 21, 2003

For: **AQUEOUS PHOSPHORIC ACID COMPOSITIONS FOR CLEANING SEMICONDUCTOR DEVICES**

APPEAL BRIEF UNDER 37 C.F.R. § 41.37

MAIL STOP APPEAL BRIEF - PATENTS
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

In accordance with the provisions of 37 C.F.R. § 41.37, Appellant submits the following:

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I. REAL PARTY IN INTEREST

The real party in interest is EKC Technology, Inc., the assignee of this application, which is a subsidiary of E. I. du Pont de Nemours and Company.

II. RELATED APPEALS AND INTERFERENCES

There are no related appeals or interferences.

III. STATUS OF CLAIMS

The pending claims are claims 1 to 35. Claims 1 to 35 stand rejected. The rejections of each of claims 1 to 35 are appealed.

IV. STATUS OF AMENDMENTS

No Amendments have been filed after receipt of the Final Office Action mailed November 23, 2005.

V. SUMMARY OF THE CLAIMED SUBJECT MATTER

There are nine independent claims pending in this application. Independent claims 1 and 24 are broad claims to aqueous compositions useful as cleaning compositions for semiconductor substrates. Independent claims 27 to 32 and 34 are "picture claims" also claiming aqueous compositions useful as cleaning compositions but which are narrowly drawn to particular preferred embodiments. The pending independent claims 24 and 27 to 31 are generally substantially as originally filed, with some amendments being made to aid in readability. Independent claims 32 and 34 were subsequently added by amendment.

INDEPENDENT CLAIM 1

Claim 1 recites a composition having a pH between about 1.5 and about 6 and comprising:

at least about 75% by weight water;

from about 0.5% to about 10% by weight phosphoric acid; and

at least one alkaline compound selected from the group consisting of:

1) a trialkylammonium hydroxide and/or a tetraalkylammonium hydroxide;

2) a hydroxylamine derivative of a certain formula (which encompasses hydroxylamine and various organic derivatives) as described in the claim;

3) one or more alkanolamines of a certain formula as described in the claim.

The formulas for the hydroxylamine derivative and for the alkanolamine are not included above to aid readability, but can be found in ¶[0057] and in ¶[0059], respectively. In addition to the positively recited compounds listed above, claim 1 also recites as optional compounds "one or more other acid compounds" and "one or more fluoride-containing compounds."

Claim 1 recites an aqueous semiconductor cleaning solution such as is broadly described in ¶¶[0022] - [0032] and more particularly similar to that described in ¶[0006] of the specification. The Applicants apologize and point out that ¶¶[0022] - [0032] are in fact one paragraph. There are some differences between the composition described in paragraph [0006] and independent claim 1.

First, ¶[0006] teaches that advantageously the pH is between about 2 to about 6 (*see, e.g.*, dependent claim 2), while claim 1 recites a pH of between about 1.5 and about 6. The pH limitation in claim 1 was added by amendment, as there was no pH recitation in the originally filed claim 1. Support for this extended pH range is found at ¶[0080] on page 13.

Second, ¶[0006] teaches a composition having as an alkaline component a quaternary ammonium compound, a hydroxylamine derivative, or mixture thereof, and further teaches the composition can further include as an optional component an alkanolamine. Currently pending claim 1 recites 1) a trialkylammonium hydroxide and/or a tetraalkylammonium hydroxide; 2) a hydroxylamine derivative of a certain formula as described in the claim; and 3) one or more alkanolamines of a certain formula as described in the claim. The major difference is ¶[0006] teaches alkanolamines as a optional component, while claim 1 recites alkanolamines in the Markush group of alkaline compounds. Support for including the alkanolamines in the Markush

group can be found in ¶¶[0025] - [0027] wherein each of the quaternary ammonium compound, the hydroxylamine derivative, and the alkanolamine are recited identically and are defined as "an alkaline compound." *See also* ¶[0055].

Third, ¶[0006] teaches a quaternary ammonium compound, while claim 1 recites a trialkylammonium or tetraalkylammonium compound. This change was brought about by amendment, and support for this amendment can be found in the specification at ¶[0056].

INDEPENDENT CLAIM 24

Independent claim 24 recites a dilute aqueous semiconductor cleaner and residue remover having a pH between about 1.5 and about 6 and comprising:

a polar solvent selected from water, or a mixture of water and one or more polar organic solvents, present in an amount of at least about 75% by weight;

phosphoric acid or salt thereof, present in an amount from about 0.1% to about 6% by weight of 85% phosphoric acid; and

hydroxylamine or a hydroxylamine derivative, present in the solution in an amount from about 0.1% to about 5% by weight not including the counterion of the hydroxylamine derivative salt, if present.

Claim 24 also recites as optional ingredients a) a tri-alkylammonium hydroxide and/or tetra-alkylammonium hydroxide, present in the solution in an amount from about 0.2% to about 5% by weight; b) an alkanolamine, present in the solution in an amount from about 0.2% to about 5% by weight; c) a fluoride-containing compound, present in the solution in an amount from about 0.001% to about 0.5% by weight; d) an other acid compound, present in the solution in an amount from about 0.05% to about 6% by weight; e) a chelating agent, present in the solution in an amount from about 0.1% to about 8% by weight; and f) a surfactant, present in the solution in an amount from about 0.01% to about 3% by weight. As optional components are not necessary claim limitations, they are not included in the previous paragraph to enhance readability.

Claim 24 recites an aqueous semiconductor cleaning solution such as is broadly described in ¶¶[0022] - [0032]. The support for the amendment of the term "quaternary ammonium

compound" to " a trialkylammonium or tetraalkylammonium compound" can be found in the specification at ¶[0056].

INDEPENDENT CLAIM 27

Independent claim 27 is substantially as filed, with minor amendments being made for section 112 reasons. This formulation is described in ¶[0035]. Independent claim 27 recites a dilute aqueous cleaner and residue remover consisting essentially of:

1) about 1.5% to about 2.5% by weight of phosphoric acid;

2) about 0.5% to about 1% by weight of a hydroxylamine or hydroxylamine derivative; and

3) about 0.005% to about 0.1% by weight of a fluoride-containing compound.

INDEPENDENT CLAIM 28

Independent claim 28 is an original claim. This formulation is described in ¶[0036]. Independent claim 28 recites a dilute aqueous cleaner and residue remover consisting essentially of:

1) about 1.5% to about 2.5% by weight of phosphoric acid;

2) about 0.5% to about 1% by weight of a hydroxylamine derivative;

3) about 0.005% to about 0.1% by weight of a fluoride-containing compound; and

4) about 5% to about 15% by weight of a polar organic solvent.

INDEPENDENT CLAIM 29

Independent claim 29 is substantially as originally filed. This formulation is described in ¶[0037], except the amendment of the term "quaternary ammonium compound" to " a trialkylammonium or tetraalkylammonium compound" as described in the specification at ¶[0056]. The word "semiconductor" in the preamble was added by amendment. Support for thisamendment can be found in ¶[0004]. Also, the word "about" that was present in the originally filed claim preceding the recitation of the weight of phosphoric acid was removed by amendment. Independent claim 29 recites a dilute aqueous semiconductor cleaner and residue remover consisting essentially of:

1) 1.5% to about 2.5% by weight of phosphoric acid; and

2) 0.5% to about 1.5% by weight of a tri- alkylammonium salt and/or tetra-alkylammonium salt.

INDEPENDENT CLAIM 30

The composition recited in independent claim 30 is as described in ¶¶[0039] - [0043]. Claim 30 is substantially as originally filed. The phrase "on the filing date of this application" was added by amendment to this claim in reply to a rejection by the Examiner, who pointed out that the compounds listed as SARA 3 hazardous compounds may change over time. When the Applicants described the formulation containing no compounds listed as SARA 3 hazardous compounds, Applicants meant no compounds in the SARA 3 list at the time of the filing of the application, and not the absence of any compounds listed in some future "SARA 3" list. This implicit meaning was made explicit in the claim.

Independent claim 30 recites a dilute aqueous cleaner and residue remover consisting essentially of:

1) about 1.5% to about 4% by weight of 85% phosphoric acid;

2) about 0.3% to about 4% by weight of oxalic acid dihydrate;

3) about 0.3% to about 4% by weight of a monofunctional organic acid;

4) about 90% to about 99% by weight of water; and

5) optionally between about 0.1% and about 1% of a chelator,

wherein the formulation contains substantially no organic solvents and no compounds listed as SARA 3 hazardous compounds on the filing date of this application.

INDEPENDENT CLAIM 31

The composition recited in independent claim 31 is as described in ¶¶[0044] - [0049]. Claim 31 is also substantially as originally filed. The phrase "on the filing date of this application" was added by amendment to this claim in reply to a rejection by the Examiner, who pointed out that the compounds listed as SARA 3 hazardous compounds may change over time. The pH limitation, supported at ¶[0080], was added by amendment.

Independent claim 30 recites a dilute aqueous cleaner and residue remover consisting essentially of:

1) about 0.5% to about 6% by weight of 85% phosphoric acid;

2) about 2% to about 12% by weight of oxalic acid dihydrate; and

3) water, wherein the pH of the cleaner and residue remover is between 1.5 and 9, and the cleaner and residue remove contains substantially no organic solvents and no compounds listed as SARA 3 hazardous compounds on the filing date of this application.

Also mentioned in claim 31 are a number of optional components, that is, optionally about 0.2% to about 15% by weight of a monofunctional organic acid; optionally between about 0.05% and 1.5% by weight of: ammonium hydroxide, an alkyl ammonium hydroxide substituted with 2 or 3 alkyl moieties independently selected from methyl and ethyl moieties, or a mixture thereof; and optionally between about 0.1% and about 1% of a chelator.

INDEPENDENT CLAIM 32

The composition recited in independent claim 32 is as described in ¶[0038]. Claim 31 was added by amendment. Independent claim 32 recites a dilute aqueous cleaner and residue remover consisting essentially of: about 1.5% to about 4% by weight of 85% phosphoric acid; about 1% to about 4% by weight of glycolic acid; and about 92% to about 97.5% by weight of water.

INDEPENDENT CLAIM 34

The composition recited in independent claim 34 recites the invention illustrated by Examples 18, 25, and 26 in the Table on page 17. Example 18 had 6% phosphoric acid and 1% glycolic acid, with the balance being water. Example 25 had 3% phosphoric acid and 2% glycolic acid, with the balance being water. Example 26 had 6% phosphoric acid and 2% glycolic acid, with the balance being water. Independent claim 34 recites a dilute aqueous cleaner and residue remover consisting essentially of: about 3% to about 6% by weight of 85% phosphoric acid; about 1% to about 2% by weight of glycolic acid; and about 92% to about 96% by weight of water.

VI. GROUNDS OF REJECTION TO BE REVIEWED ON APPEAL

1. Claims 1-13, and 17-28 stand rejected under 35 U.S.C. §103(a) as being obvious over U.S. Patent No. 6,030,932 to Leon *et al.* ("Leon"), in view of U.S. Patent No. 6,686,297 to Gogg *et al.* ("Gogg").

2. Claims 1-5, 7-8, 14, and 29 stand rejected under 35 U.S.C. §103(a) as being obvious over U.S. Patent No. 6,121,219 to Herdt *et al.* ("Herdt").

3. Claims 1, 14-16, 24-25, and 30-31 stand rejected under 35 U.S.C. §103(a) as being obvious over U.S. Patent No. 6,559,370 to Skee ("Skee '370").

4. Claims 30-31 stand rejected under 35 U.S.C. §103(a) as being obvious over U.S. Patent No. 6,465,403 to Skee ("Skee '403").

5. Claims 33-35 (and presumably claim 32) stand rejected under 35 U.S.C. §103(a) as being obvious over U.S. Patent No. 6,309,470 to Schulhoff *et al* ("Schulhoff").

VII. ARGUMENT

1. Rejection of Claims 1-13 and 17-28 Over Leon And Gogg.

Claims 1-13 and 17-28 stand rejected under 35 U.S.C. §103(a) as being obvious over Leon in view of Gogg. The Examiner states that Leon discloses a cleaning composition which comprises water, a hydroxylamine or quaternary ammonium compound, and a fluorine-containing compound, and teaches that the pH of the composition should be between 2-9. The Examiner acknowledges that Leon does not teach phosphoric acid. The Examiner contends that Gogg describes a cleaning composition which includes among its many ingredients a pH adjusting additive, and Gogg teaches that phosphoric acid can be added as an additive for adjusting the pH to a desired level, thereby increasing the effectiveness of the cleaning composition.

No Motivation To Combine The References

There is no motivation for one of ordinary skill in the art to combine the disclosures of Leon and Gogg. Applicants concede that both Leon and Gogg address the problem of removal of some type of residue from a semiconductor. The removal systems of Claim 1, Leon, and Gogg are summarized in Table 1 below. However, each of the fluids work with different ingredients, and there is no reason to combine the fluids, and no reasonable expectation of success were the fluids combined. Each of claim 1, Leon, and Gogg recite a composition comprising water. Each of claim 1, Leon, and Gogg further recite at least one of an amine, a hydroxylamine, or an ammonium compound of some type. Claim 1 recites as an active required component phosphoric acid (H_3PO_4), Leon recites as an active required component a fluoride-containing component, and Gogg recites as an active required component ozone. The required ingredients and optional ingredients for each of claim 1, Leon, and Gogg are summarized in Table 1. The recitations of independent claim 24 are similar to the recitations of independent claim 1 for purposes of this argument, and arguments pertaining to claim 1 include by reference claim 24.

Components	Claim 1	Leon	Gogg
Required	> about 75% water	water	water
Required	0.5% to 10% H_3PO_4	0.5% to 10% of a fluoride-containing compound (HF)	ozone
Required	at least one of: a tri- or tetra-alkylammonium hydroxide; a hydroxylamine derivative; or an alkanolamines.	1% to 70% of a hydroxylamine derivative, 0r 0.1% to 10% of an amine, a quaternary ammonium compound, or ammonium hydroxide	a large amount of ammonium hydroxide
pH	1.5 - 6	2 - 9	
Optional	"other acid compounds"	up to 0.5% chelators	HF or H_3PO_4 to adjust the pH, stabilize ozone
	fluoride-containing compounds	corrosion inhibitors and surfactants.	HF or HCl to enhance cleaning

Leon discloses a cleaning composition comprising 1) water, 2) a fluorine-containing compound, and 3) either a compound selected from an amine, a quaternary ammonium compound, and ammonium hydroxide, or a hydroxylamine or a salt thereof. *See* Leon Abstract. Leon indeed that a pH of 2-9 is desired such to minimize attack on metal layers. Selected organic acids are taught by Leon to be corrosion inhibitors, in particular lactic acid, gallic acid, and gallic acid esters, which can be admixed into the composition. However, Leon does not suggest using any pH adjusting compounds to obtain the desired pH. Instead, Leon at column 5, lines 13-21, expressly teaches:

> the components in the cleaning composition <u>should be admixed in appropriate concentrations</u> to provide a composition having a pH

with a preferred range from about 2 to 9, and more preferably from about 2 to 6.

See also Leon at column 6, lines 30-35. Leon teaches a composition with a balanced amount of the acidic fluorine-containing compounds, the alkaline amine or hydroxylamine compounds, and optionally organic acid chelators, the components being present to provide a pH of 2 to 9.

The Examiner's stated motivation, that one of skill in the art would borrow from Gogg a particular pH adjusting agent for use in the formulation of Leon is contrary to the express teachings of Leon.

Gogg addresses the problem of cleaning a semiconductor substrate by contacting a substrate with water having a high concentration of ozone, ammonium hydroxide and optionally other additives which are not repugnant to ozone at elevated temperature.. *See* Gogg at column 1, lines 38-46, and at column 2, lines 16-18. Additives are added to target certain contaminants and "to enhance the effectiveness of the cleaning." *See* Gogg at column 1, lines 23-31, and at column 3, lines 51-53. Gogg suggests as additives 1) an acid, giving examples which are HF or phosphoric acid, 2) a base, of which the only example given is ammonium hydroxide, or 3) a mixture of an acid and a base. *See* Gogg at column 1, lines 23-31, and at column 3, lines 51-57. Gogg does not teach compositions having both HF and phosphoric acid. Gogg teaches use of phosphoric acid or a buffer of phosphoric acid and ammonia in his aqueous solution comprising ozone, which are advantageously included to stabilize ozone. *See* Gogg, column 5, lines 15-27. Gogg does not recommend phosphoric acid for cleaning purposes, that is, for removal of contaminants, organics, and particles. Gogg recommends as additives ammonium hydroxide "for particle and organic removal," and with respect to acids states:

> "other additives that enhance the cleaning capability of the treatment include hydrofluoric acid (HF) and hydrochloric acid (HCI). Such additives have the following benefits/effects: 1) removal of organic contaminants; 2) removal of oxide and regeneration of a controlled chemical oxide; 3) removal of particles; 4) removal of metals."

See Gogg at column 3, lines 23-31, and at column 3, lines 51-57.

To summarize, Gogg teaches an aqueous composition comprising a large amount of ammonium hydroxide, a large amount of ozone, optionally HF or HCl to enhance cleaning, and optionally H_3PO_4 or HF to stabilize ozone.

Leon does contemplate the use of his invention in combination with ozonated water to strip off photoresists and other residues. Leon suggests using ozonated water in a step performed sequentially with contacting the semiconductor with his cleaner. *See* Leon at column 6, lines 49-63. By "in combination with," Leon clearly teaches sequential operations, a first cleaning step using ozonated water and a second cleaning step using his cleaner composition. See e.g., Leon at column 6 lines 40-48 where Leon teaches using his cleaner "in combination with" dry stripping. Clearly, the term "in combination with" as used by Leon implies sequential actions, as it is impossible to simultaneously use dry stripping while using an aqueous cleaner. There is therefore no teaching or suggestion in Leon to add ozonated water to his cleaner composition.

The Examiner uses Leon as a primary reference. The Examiner opines that rather than using fluoride-containing compounds and selected organic acids, which are taught by Leon to have primary uses as a dissolver and as chelator respectively but which also lower the pH of the composition, that one of ordinary skill in the art would look elsewhere for a mineral acid to provide the desired pH. Leon teaches the use of a fluoride-containing compound, in particular HF. This is the same compound Gogg teaches to be useful to enhance cleaning and to stabilize ozone. There is suggestion in Leon to add HF, and Gogg provides additional motivation to add HF as Gogg states HF enhances cleaning. But Gogg does NOT state H_3PO_4 enhances cleaning. There is no teaching in Leon to use a pH adjusting agent, and in fact Leon teaches against the use of pH adjusting agents. By turning to Gogg for a pH adusting compound other than HF, the Examiner is disregarding the teaching of Leon, implying that any concentration of an acidic fluoride, optional organic acids, and an amine are useful, as you can always add any pH adjustors (such as the phosphoric acid taught by Gogg to be a useful ozone stabilizer) to adjust the pH to a desired level.

Applicants believe the motivation to combine the H_3PO_4 of Gogg with the formulation of Leon, which was provided by the Examiner, is mere pretence to justify hind-sight, and is contrary to the express teaching in Leon. The Examiner combines selected portions of

Leon with selected portions of Gogg in a classic hindsight reconstruction of the invention. Leon teaches an aqueous composition with a balanced amount of acidic fluorine-containing compounds and alkaline amine or hydroxylamine compounds, where the proportions of the compounds are such that the pH is 2-9. Gogg teaches HF or phosphoric acid in ozonated water, where HF is useful to enhance cleaning and to stabilize ozone, while phosphoric acid is useful as a pH adjustor that stabilizes ozone. The Examiner, when faced with Gogg's teaching to use acidic fluorides to provide added cleaning power or phosphoric acid to stabilize ozone, suggests that one of skill in the art would choose the phosphoric acid (the ozone stabilizer) over the acidic fluoride (which is a cleaner enhancer, as is also taught by Leon) to adjust the pH of the composition after ignoring Leon's instructions to formulate a pH balanced composition of the acidic fluoride and the amines, even though the composition of Leon has no ozone. It is Applicants position that the Examiner has not provided sufficient motivation for the combination of the references, and has shown no motivation for the specific components combined. Applicants therefore respectfully request reconsideration of the rejection of claims 1-13 and 17-28 over the combination of Leon and Gogg.

In the interests of resolving all issues, we note that while Leon does not disclose the presence of phosphoric acid in this cleaning composition, Leon teaches that hydroxylamine can be reacted with an acid ("*e.g.*, nitric acid or sulfuric acid;" *see* Leon, column 4, line 40) to form a hydroxylamine salt, which can then be added to the composition. Leon also teaches that hydroxylammonium phosphate is a potentially useful hydroxylamine salt. *See Id.*, column 4, line 45. Such hydroxylamine salts are indeed acidic. However, independent claims 1 and 24, as amended, recite cleaning or residue-removing compositions comprising hydroxylamine or a salt, phosphoric acid, and water. While initially it might seem like hydroxylammonium phosphate (chemical formula = $(H_3N^+OH)_3[(PO_4)^{-3}]$) is merely a reaction product of hydroxylamine and phosphoric acid, such is not the case when these components are added to cleaning compositions. Indeed, the dissociation pKa of the three phosphoric acid protons are approximately 2.1, 7.2, and 12.7, respectively. Thus, in order to react phosphoric acid with hydroxylamine, or to separate phosphoric acid from hydroxylammonium phosphate, the pH of that solution would have to be above about 12.7. While Leon teaches that its compositions can have a wide pH range (2-9), it

also cautions against solutions that are too caustic (e.g., a pH of 12.7), noting that, at extreme pH values, "the metal layers on the substrate are subject to attack." *See Id.*, column 5, lines 13-21. Therefore, Leon does not incidentally teach a composition comprising phosphoric acid. The Examiner has not disputed Applicants' distinguishing of Leon from claims 1-13 and 17-28, and indeed noted that Applicants' arguments were persuasive on page 2 of the Office Action.

Combination of References Does Not Teach the Invention of Claims

Finally, there are additional arguments that are pertinent to selected dependent claims. Even assuming, *arguendo*, that Gogg teaches the potential use of phosphoric acid in Leon's cleaning composition, Applicants respectfully submit that Gogg still does not remedy the deficiencies of Leon with respect to certain claims.

Independent claim 1

Independent claim 1 recites 0.5% to 10% of phosphoric acid. There is no teaching in either Leon nor Gogg on any amount of phosphoric acid to be included. The Examiner has offered the rationalization that the exact concentration of compounds is obvious because "it would have been obvious to optimize as the optimization of a result effective variable involves only routine experimentation. This rationalization is fatally deficient – phosphoric acid is taught be Gogg to stabilize ozone. How would one on ordinary skill in the art test to find an optimum amount of phosphoric acid? There is no ozone in the recited compositions that needs stabilizing, and if there was, there is no teaching in the references that the amount of phosphoric acid needed to optimally stabilize the ozone would fall within the claimed range. The routine experimentation could not be used to optimize cleaning – phosphoric acid is not taught by the references to promote cleaning.

The routine experimentation might be to optimize cleaning while minimizing metal corrosion and pitting - Applicants optimized their compositions by testing plasma etch residue removal, corrosion, and pitting of titanium nitride/ aluminum-copper alloy/titanium-titanium nitride/silica wafers as described in the instant application at ¶[0094]. Further, while Applicants found that all the described formulations were non-corrosive, the more informative test was pitting. *See* the instant application at ¶[0094]. But that would be using the Applicant's own disclosure in hindsight reconstruction of the invention. Leon teaches his compositions are non-

corrosive in column 1 lines 9-14, but does not teach which substrates that his compositions are non-corrosive toward. Leon does not consider metal pitting. Gogg does not mention metal pitting, but only states at column 3 lines 62-64 that ozone gas prevents pitting of silicon by ammonium hydroxide. Of course, neither ozone nor ammonium hydroxide are present in the composition of claim 1, and pitting of silicon is unrelated to pitting of metals. Therefore, there is no substrate taught or suggested in the cited art to run experiments to obtain optimization, and further the most informative test used by Applicants is not taught or suggested by either Leon or Gogg. Therefore, the rationalization of routine experimentation to optimize concentrations is without scientific basis.

The Examiner might suggest that the amount of phosphoric acid is that amount sufficient to obtain the desired pH, but that is circular – the amount of phosphoric acid needed to obtain the desired pH depends on the amounts of every other component in the composition.

Examiners obviousness argument can be best characterized as use of a component from the secondary reference without regard for the primary use of this component as taught in the secondary reference, and incorporation of this component into the composition of the primary reference expressly against the teaching of the primary reference, followed by optimization of concentration by routine experimentation when neither the substrates to be tested nor the most informative test itself is taught or suggested in either prior art reference. Applicants respectfully request that the rejection of independent claim 1 over Leon in view of Gogg be reconsidered.

Claim 10

Leon expressly requires 0.5% to 10% of a fluoride-containing compound, and Gogg teaches that HF enhances cleaning and stabilizes ozone, but does not suggest a concentration of HF which might be useful. Claim 10 recites a fluoride containing compound present in an amount between 0.01% and 0.1%. As these ranges clearly do not overlap, routine investigation to optimize will never reach the claimed concentration. Further, there is no motivation to look at lower concentrations of fluoride containing components than is disclosed in Leon, as these components are taught to enhance cleaning in both Gogg and Leon. Leon does not teach the invention alone or in combination with Gogg, and Applicants respectfully request that the rejection of claim 10 over Leon in view of Gogg be reconsidered.

Claims 12 and 13

With respect to claim 12, neither Leon nor Gogg teach or suggest including about 5% to about 15% by weight of an organic solvent in their compositions. Leon teaches against the use of organic solvents. *See* Leon at column 3, lines 60-65. Gogg at column 5 lines 22-27 suggest acetone in some undisclosed quantity is useful to stabilize ozone. With respect to claim 13, neither Leon nor Gogg teach or suggest including about 5% to about 15% by weight of an organic acid ester. Applicants respectfully request that the rejection of claims 12 and 13 over Leon in view of Gogg be reconsidered.

Claim 18

Claim 18 recites the cleaner is substantially free of fluoride-containing compounds. the term "substantially free" is defined in the instant specification at ¶[0018]. The Examiner rejected claim 18 over Leon in view of Gogg. Leon expressly requires 0.5% to 10% of a fluoride-containing compound, and Gogg teaches that HF enhances cleaning and stabilizes ozone, but does not suggest a concentration of HF which might be useful. As the references do not teach the claimed invention, Applicants respectfully request that the rejection of claim 18 over Leon in view of Gogg be reconsidered.

Independent claim 24

Independent claim 24 recites 0.1 to 6% of phosphoric acid (85% active). There is no teaching in either Leon nor Gogg on any amount of phosphoric acid to be included. The Examiner has offered the rationalization that the exact concentration of compounds is obvious because "it would have been obvious to optimize as the optimization of a result effective variable involves only routine experimentation. This rationalization is fatally deficient, as phosphoric acid is taught be Gogg to stabilize ozone. For brevity, rather than be repeated, the arguments presented above with respect to claim 1 provided above are incorporated here by reference.

The Examiner might suggest that the amount of phosphoric acid is that amount sufficient to obtain the desired pH, but that is circular – the amount of phosphoric acid needed to obtain the desired pH is dependent on the amount of basic material such as quaternary ammonium compounds AND on the amount of other acidic material such as HF. Claim 24 recites between 0.1% and 5% of the amine, hydroxylamine, or teriary or quaternary ammonium compound.

Further, Applicants optimized with a composition of at most 0.001% to about 0.5% by weight of a fluoride-containing compound, while Leon teaches 0.5% to 10%. There is no reason to suspect that routine experimentation at the very bottom of the range of fluoride-containing compound taught be Leon would result in the optimization to the values recited in claim 24, especially in view that the compositions in claim 24 were tested against materials not taught or suggested in either prior art reference, and since the most informative test – metal pitting – is not taught or suggested in either prior art reference.

Examiners obviousness argument can be best characterized as use of a component from the secondary reference without regard for the primary use of this component as taught in the secondary reference, and incorporation of this component into the composition of the primary reference expressly against the teaching of the primary reference, followed by optimization of concentration by routine experimentation when neither the substrates to be tested nor the most informative test itself is taught or suggested in either prior art reference. Applicants respectfully request that the rejection of independent claim 24 over Leon in view of Gogg be reconsidered.

Claims 25 and 26

Leon at column 4 lines 57-59 states the fluoride-containing compound is present in an amount between 0.5% to 10%. Claims 25 and 26 each recite a fluoride containing compound present in an amount between 0.005% and 0.04%. As these ranges clearly do not overlap, routine investigation to optimize will never reach the claimed concentration. Further, there is no motivation to look at lower concentrations of fluoride containing components than is disclosed in Leon, as these components are taught to enhance cleaning in both Gogg and Leon. Leon does not teach the invention alone or in combination with Gogg, and Applicants respectfully request that the rejection of claims 25 and 26 over Leon in view of Gogg be reconsidered.

Independent claim 27

Independent claim 27 recites dilute aqueous cleaner and residue remover consisting essentially of: about 1.5% to about 2.5% by weight of phosphoric acid; about 0.5% to about 1% by weight of a hydroxylamine or hydroxylamine derivative; and about 0.005% to about 0.1% by weight of a fluoride-containing compound. Neither reference teaches the recited amount of phosphoric acid, as explained in the arguments above relating to claims 1 and 24, which are

incorporated here by reference. Leon at column 4 lines 57-59 states the fluoride-containing compound is present in an amount between 0.5% to 10%. Claim 27 recites a fluoride containing compound present in an amount between 0.005% and 0.1%. As these ranges clearly do not overlap, routine investigation to optimize will never reach the claimed concentration. Further, there is no motivation to look at lower concentrations of fluoride containing components than is disclosed in Leon, as these components are taught to enhance cleaning in both Gogg and Leon. Leon does not teach the invention alone or in combination with Gogg, and Applicants respectfully request that the rejection of claim 27over Leon in view of Gogg be reconsidered.

2. Rejections Over Herdt.

Claims 1-5, 7-8, 14, and 29 stand rejected under 35 U.S.C. §103(a) as being obvious over Herdt.

Non-Analogous Art

We note the Examiner rejected the above claims as being obvious over Herdt, as opposed to being anticipated by Herdt. We believe this decision of selecting obviousness as opposed to anticipation is correct, but we note that as the reference is from non-analogous art it does not teach all the limitations of the claims. Independent claim 1 recites "an aqueous semiconductor cleaning solution." Independent claim 29 recites "a dilute aqueous semiconductor cleaner and residue remover." It is well known to one of ordinary skill in the art that semiconductor cleaners must have a number of inherent properties, including extremely low levels of metal ions and extremely low levels of corrosion toward a number of metals. *See* for example the reference Gogg discussed above, at column 5 lines 30-33, which teaches "in practical terms, salts which include metals such as sodium are in general not acceptable for semiconductor applications. *See also* for example the reference Leon discussed above which states at column 3 lines 35-38 that "especially severe contaminants to microcircuits are residues ... which contain metal contaminants including alkaline metals such as sodium, potassium, and the like." While generally the preamble of a claim is given little patentable weight, Applicants would have no reason to refer to the cleaners/residue removers of presently amended independent claims 1 and 29 as semiconductor cleaner and residue remover compositions were it not to distinguish them from any other composition of matter. Applicants clearly in the prosecution history stated that

the phrase "semiconductor cleaner" is a limitation on the claims, and even added the limitation by amendment to claim 29. Applicants' characterization is not merely an expression of intended use, but more properly is a descriptive element of the compositions that breathes life into presently amended claims 1 and 29, as well as those claims depending therefrom. Such cleaners have a number of implicit limitations known to those of ordinary skill in the art, including such limitations such as the stringent metal ion concentration.

Herdt is drawn to compositions and methods for cleaning organic beverage and food soils to remove carbohydrate and proteinaceous contaminants. *See, e.g.*, Herdt Abstract. Nowhere is it disclosed, or even suggested, that the compositions of Herdt can be used to clean semiconductor substrates, as recited in instant independent claims 1 and 29, as amended. Herdt continually teaches adding sodium and potassium salts as components of his cleaner. See Herdt, at column 5 at lines 1-4; at column 5 at lines 19-25; at column 5 at lines 43-48; and at column 6 at lines 33-43. Herdt also teaches at column 4 lines 31-40 that particulate ion exchange material be in the composition. Such particles would be fatal to semiconductor substrates. Thus, Applicants respectfully submit that Herdt does not disclose or suggest all the elements of the rejected claims.

Further, as the art for cleaning organic beverage and food soils to remove carbohydrate and proteinaceous contaminants is clearly not analogous to the semiconductor substrate cleaning art, Applicants respectfully submit that one of ordinary skill in the art would have had no motivation to look to such non-analogous art nor any reasonable expectation of success in modifying the compositions of Herdt to be useful as a semiconductor cleaner in order to attain the invention recited in independent claims 1 and 29, as amended. Therefore, in light of the foregoing, Applicants respectfully submit that an obviousness rejection based on the Herdt disclosure cannot be maintained and has been overcome. Applicants respectfully request that the obviousness rejection thus be reconsidered and withdrawn.

The Cleaner of Hertd Does Not Meet All Limitations of Dependent Claims 3-4 and 29

The concentrate formulations of Herdt are provided in Herdt in the Table 1 at column 14, lines 40-49. In its broadest disclosure, Herdt teaches a cleaner concentrate having 0.1-80% H_3PO_4, 0.1-40% organic acid, 0.1-40% hydrocarbon or ether solvent, 0.1-40% sequestrant, 0.1-

40% of an ether amine or quaternary ammonium salt, and 0.1-80% water. The Examiner notes that Herdt at column 3 lines 7-36 that Herdt teaches a pH of 1-5. However, this is not the pH of the cleaner concentrate but is rather the pH of the cleaner composition. *See* Herdt at column 3, lines 15-20. To make the cleaner, the concentrate composition of Herdt (described in Table 1 in column 14) is diluted with water to provide a 100 ppm to about 20,000 ppm formulation (0.01% to about 2% by weight) of the concentrate in water. *See* Herdt at column 14, lines 50-52. Using the broades disclosure of Table 1 at column 14 of Herdt with the dilution factor of column 14, lines 50-52, it is readily calculated that the cleaning compositions of Herdt has 0.00001% to 1.6% phosphoric acid, 0.00001% to 0.8% organic acid, 0.00001% to 0.8% solvent, 0.00001% to 0.8% sequestrant, and 0.00001% to 0.8% ether amine or quaternary ammonium compound, wherein the cleaner has at most 2% total of active ingredients. This calculation is based on the broadest disclosure of 0.1-80% phosphoric acid in the concentrate as taught in Table 1 in column 14 of Herdt, which is clearly much different than the preferred range of 0.1% to 40% of phosphoric acid taught in the preferred composition in said Table 1. Using the preferred composition of the concentrate as taught in Table 1 of Herdt, the actual cleaner of Herdt which has a pH of 1-5 would have 0.00001% to 0.8% phosphoric acid and 0.00001% to 0.2% of an ether amine or quaternary ammonium compound.

Claims 3 and 4

Claims 3 and 4 require hydroxylamine or a hydroxlyamine derivative. With respect to claims 3-4, Herdt does not teach any hydroxylamine compounds. Hydroxylamine derivative compounds have a formula $N(R_1, R_2, -OR_3)$, where each R is a hydrogen or an alkyl. Quaternary ammonium compounds have the formula $N(R_1, R_2, R_3, -OH)$, where each R is a hydrogen or an alkyl. None of the quaternary ammonium compounds of Herdts are hydroxylamine compounds.

Further, the most preferred concentrate of Herdt will provide actual cleaner of Herdt which has a pH of 1-5 would have 0.00001% to 0.8% phosphoric acid and 0.00001% to 0.2% of an ether amine or quaternary ammonium compound. Claim 3 recites 0.3% to 1% of a hydroxylamine derivative. With respect to claim 3, not only do the compounds not match but additionally the preferred amount of basic component taught in the reference is somewhat below

the amount of hydroxylamine recited in the claim. Applicants respectfully request that the obviousness rejection of claims 3 and 4 over Herdt be reconsidered and withdrawn.

Claim 29

With respect to claim 29, claim 29 recites an aqueous composition consisting essentially of 0.5% to 1.5% of a tri or tetraalkylammonium salt and at least 1.5% to 2.5% by weight of phosphoric acid. The composition of Herdt requires 2% maximum of active ingredients, which further includes an organic acid, a hydrocarbon or ether solvent, and a sequestrant. While the broadest disclosure of Herdts (using 75% phosphoric acid and 25% quaternary ammonium salt in the concentrate of Herdt, which is within the 0.1% to 80% disclosed for phosphoric acid and within the 0.1% to 40% disclosed for the quaternary ammonium compound) when admixed at its maximum concentration into water disclosed by Herdt, can meet the limitations of claim 29, so long as the amounts of organic acid, hydrocarbon or ether solvent, and sequestrant each be negligible, this is a stretch of the disclosure of Herdt that is clearly not within the teaching of Herdt. Using the preferred composition of the concentrate as taught in Table 1 of Herdt, the actual cleaner of Herdt which has a pH of 1-5 would have 0.00001% to 0.8% phosphoric acid and 0.00001% to 0.2% of an ether amine or quaternary ammonium compound. Both of these values are below the values recited in claim 29. Applicants respectfully request that the obviousness rejection of claim 29 over Herdt be reconsidered and withdrawn.

3. Rejections Over Skee '370

Claims 1, 14-16, 24-25, and 30-31 stand rejected under 35 U.S.C. §103(a) as being obvious over Skee '370.

Claims 1 and 14-16

Skee '370 discloses aqueous alkaline compositions for stripping or cleaning semiconductor wafers that contain one or more metal ion-free bases at sufficient amounts to produce a pH of about 10-13 and one or more bath stabilizing agents having at least one pKa in the range of 10-13 to maintain this pH, as well as many other optional components. *See* Skee '370 Abstract, column 4 at lines 20-27, and column 6 at lines 25-37. Independent claim 1 recites aqueous semiconductor cleaners/residue removers having a pH between about 1.5 and about 6,

which is in contrast to the teachings of Skee '370, which require a pH of 10-13. Thus, Skee '370 does not disclose or suggest all the elements of independent claim 1, as well as of claims 14-16 depending therefrom. Applicants respectfully request that the obviousness rejection of claims 1 and 14-16 over Skee '370 be reconsidered and withdrawn.

Independent claim 24 and 25

Skee '370 discloses aqueous alkaline compositions for stripping or cleaning semiconductor wafers that contain one or more metal ion-free bases at sufficient amounts to produce a pH of about 10-13 and one or more bath stabilizing agents having at least one pKa in the range of 10-13 to maintain this pH, as well as many other optional components. *See* Skee '370 Abstract, column 4 at lines 20-27, and column 6 at lines 25-37. Independent claim 24 recites aqueous semiconductor cleaners/residue removers having a pH between about 1.5 and about 6, which is in contrast to the teachings of Skee '370, which require a pH of 10-13. Thus, Skee '370 does not disclose or suggest all the elements of independent claim 24, as well as of claims 25 depending therefrom. Applicants respectfully request that the obviousness rejection of claims 24 and 25 over Skee '370 be reconsidered and withdrawn.

Further, claim 25 recites a composition consisting essentially of water, the phosphoric acid, the hydroxylamine or hydroxylamine derivative, and flouride-containing compound. Skee '370 teaches the formulations contain a water-soluble metal-ion-free silicate. *See* Skee '370 Abstract and at column 6 at lines 41-46. While Skee '370 purports to include the silicate as optional, the only non-optional ingredient in Skee '370 is one or more of the bath stabilizing agents having a pKa in the range of 10 to 13, including among other examples phosphoric acid. The silicate is required in the composition of Skee '370. See, e.g., claim 1 of Skee '370 which recites a base to give pH of 11 or higher, a bath stabilizing agent having a pKa in the range of 10 to 13, and the silicate. The Examiner pointed with particularity to the Example described at column 10 lines 5-10 in making his prima facie case of obviousness. This example is described below:

> the composition is an aqueous solution containing about 0.1-5% by weight tetramethylammonium hydroxide (TMAH), about 0.1% to about 3% by weight sulfosalicylic acid or phosphoric acid, about

0.01-1% by weight trans-(1,2-cyclohexylenedinitrilo)tetraacetic acid (CyDTA), and about 0-1% by weight (calculated as % SiO_2) tetramethylammonium silicate (TMAS).

Applicants submit that the presence of a 0.01-1% of trans-(1,2-cyclohexylenedinitrilo)tetraacetic acid (CyDTA) might bring this composition outside the range encompasses by the term "consisting essentially of" as used in claim 25. For this additional reason, Applicants respectfully request that the obviousness rejection of claim 25 over Skee '370 be reconsidered.

Independent claim 30

Claim 30 recites a composition that consists essentially of about 1.5% to about 4% by weight of 85% phosphoric acid; about 0.3% to about 4% by weight of oxalic acid dihydrate; about 0.3% to about 4% by weight of a monofunctional organic acid; about 90% to about 99% by weight of water; and optionally between about 0.1% and about 1% of a chelator. Each and every compound listed above, with the exception of water, is acidic. The composition of claim 30 MUST be acidic, and indeed must have a pH considerably less than 6. Skee '370 discloses aqueous alkaline compositions for stripping or cleaning semiconductor wafers that contain one or more metal ion-free bases at sufficient amounts to produce a pH of about 10-13 and one or more bath stabilizing agents having at least one pKa in the range of 10-13 to maintain this pH, as well as many other optional components. *See* Skee '370 Abstract, column 4 at lines 20-27, and column 6 at lines 25-37. Thus, Skee '370 does not disclose or suggest all the elements of independent claim 30. Applicants respectfully request that the obviousness rejection of claim 30 over Skee '370 be reconsidered.

Independent claim 31

Claim 31 recites a range of allowable pH from about 1.5 and 9. Skee '370 discloses aqueous alkaline compositions for stripping or cleaning semiconductor wafers that contain one or more metal ion-free bases at sufficient amounts to produce a pH of about 10-13 and one or more bath stabilizing agents having at least one pKa in the range of 10-13 to maintain this pH, as well as many other optional components. *See* Skee '370 Abstract, column 4 at lines 20-27, and column 6 at lines 25-37. There is no overlap of pH 1.5 to 9 recited in claim 31 and pH 10-13 recited in Skee '370. Thus, Skee '370 does not disclose or suggest all the elements of

independent claim 31. Applicants respectfully request that the obviousness rejection of claim 31 over Skee '370 be reconsidered.

4. Rejections Over Skee '403

Claims 30-31 stand rejected under 35 U.S.C. §103(a) as being obvious over Skee '403. The disclosure of Skee '403 is substantially the same as that of Skee '370, and the arguments for patentability of claims 30 and 31 are therefore identical.

Independent claim 30

Skee '403 discloses aqueous alkaline compositions for stripping or cleaning semiconductor wafers that contain one or more metal ion-free bases at sufficient amounts to produce a pH of about 10-13, preferably greater than 11, and one or more bath stabilizing agents having at least one pKa in the range of 10-13 to maintain this pH, and also optionally comprise a silicate (defined as a chelator), as well as many other optional components. *See* Skee '403 Abstract and column 5, lines 35-40.

Claim 30 recites an aqueous semiconductor cleaners/residue removers that consists essentially of water, at least 1.5% phosphoric acid, at least 0.3% if oxalic acid, and at least 0.3% of a monofunctional organic acid. While claim 30 allows for up to 1% of an unspecified chelator, any composition of claim 30 must be acidic. As Skee '403 teaches alkaline cleaners, and more particularly cleaners having a pH of 10 to 13, Skee '403 does not disclose a composition which meets the limitation of claim 30. Applicants respectfully request that the obviousness rejection of claim 30 over Skee '403 be reconsidered.

Independent claim 31

Claim 31 recites a composition consisting essentially of phosphoric acid, oxalic acid, optionally a monofunctional organic acid, optionally ammonium hydroxide or a bi or tri-alkyl substituted ammonium hydroxide, and a chelator. Claim 31 recites an allowable pH of from about 1.5 and 9. Skee '403 requires a pH of 10 or greater. As Skee '403 teaches alkaline cleaners, and more particularly cleaners having a pH of 10 to 13, Skee '403 does not disclose a composition which meets the limitation of claim 31. Applicants respectfully request that the obviousness rejection of claim 31 over Skee '403 be reconsidered.

4. Rejections Over Schulhoff

Claims 33-35, and presumably claim 32, stand rejected under 35 U.S.C. §103(a) as being obvious over Schulhoff.

Independent claim 32 and claim 33

The Examiner did not reject claim 32 over Schulhoff. However, claim 33 depends from claim 32, and by law if Schulhoff makes obvious claim 33 it must also make obvious claim 32.

Claim 32 recites a dilute aqueous cleaner and residue remover consisting essentially of: about 1.5% to about 4% by weight of 85% phosphoric acid; about 1% to about 4% by weight of glycolic acid; and about 92% to about 97.5% by weight of water. The Examiner cites a section of Schulhoff in his rejection, wherein the only disclosures of compositions containing phosphoric acid and glycolic acid is in the tables at column 2 lines 39-54 of Schulhoff.

This Table describes a composition that has 12.9% phosphoric acid, 14.6% glycolic acid, about 48% water, AND 2% sulfamic acid, 10% citric acid, 1.8% RODINE® which is of unknown composition; 10% hydrochloric acid, and 0.4% inhibitors. We believe "RQDINE" refers to "RODINE" brand inhibitors (e.g., Rodine 31a or Rodine 426 or Rodine 213) used with acid to clean such things as water tanks, and which contain a variety of proprietary ingredients.

To say that a composition as disclosed in this first Example teaches a composition as claimed in claim 32 consisting essentially of water, 1.5-4% phosphoric acid, and 1-4% glycolic acid obvious stretches every bound of credibility. First, the numerical limitations of claim 32 must be absolutely ignored, as neither the phosphoric acid nor the glycolic acid disclosed in Schulhoff are within a factor of three of the claimed amounts. The Examiner rationalizes that concentrations can be "optimized", using the same fallacious reasoning discussed above. The composition of Schuloff is used for cleaning water wells and water tanks! What criteria would one of ordinary skill in the art use when faced with the disclosure of Schulhoff. The composition described in Schulhoff doubtless would clean residue, and doubtless would ruin every semiconductor substrate it touched. (Applicants concede that claim 32 does not expressly recite that the cleaner is a semiconductor cleaner, but that claim 33 depending from claim 32 describes the composition of claim 32 as a "semiconductor cleaning solution of claim 32.) The only "routine experimentation" that would uncover the instant invention is testing of every combination of components listed in this table – that would be 1*2*3*4*5*6*7 = 5040

combinations of chemicals, and essentially an infinite number of concentrations, where eventually one might find that reducing the phosphoric acid and glycolic acid by a factor of four and substantially eliminating sulfamic acid, citric acid, RQDINE®, hydrochloric acid, and the inhibitors would one of ordinary skill in the art stumble on the invention. Conducting such an experiment, with many tens of thousands of likely combination/concentration embodiments, with no motivation, suggestion, or teaching in the cited art to try such experimentation, with no guidance on the utility of the various compounds listed, with no teaching or suggestion of which substrates to test, and with no teaching or suggestion on which parameters to "optimize", makes a mockery of the phrase "optimization of a results effective variable involves only routine skill in the art."

And then the Examiner's case gets even worse. Claim 33 depends from claim 32, and bolsters the "consisting essentially of" language of claim 32 by reciting the composition is substantially free from: alkanolamines, quaternary ammonium compounds, hydroxylamine and hydroxylamine derivatives, other acid compounds (*e.g.*, the 10% hydrochloric acid and 2% sulfamic acid in Schulhoff), fluoride-containing compounds, organic solvents, non-hydroxyl-containing amines, chelating agents (*e.g.*, the 10% citric acid in Schulhoff), and surfactants (*e.g.*, the 1.8% RODINE in Schulhoff). The only way to suggest the composition described in Schulhoff makes the composition of claim 33 is to totally ignore the limitations of claim 33.

As Schulhoff teaches a cleaner meeting absolutely none of the limitations of claims 32 and 33, Applicants respectfully request that the obviousness rejection of claim 33 (and by inference of claim 32) over Schulhoff be reconsidered.

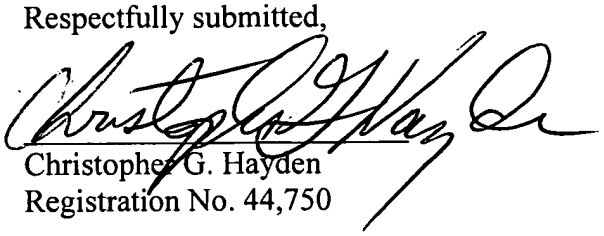
Independent claim 34 and claim 35

Claim 32 recites a dilute aqueous cleaner and residue remover consisting essentially of: about 3% to about 6% by weight of 85% phosphoric acid; about 1% to about 2% by weight of glycolic acid; and about 92% to about 96% by weight of water. Independent claim 34 is very similar to independent claim 32, but with minor differences in the claimed concentrations. Similarly, dependent claim 35 is similar to dependent claim 33 discussed above. The arguments for independent claim 34 and dependent claim 35 are therefore the same as the arguments regarding independent claim 32 and dependent claim 33 described above, and are incorporated

here by reference thereto. As Schulhoff teaches a cleaner meeting absolutely none of the limitations of claims 34 and 35, Applicants respectfully request that the obviousness rejection of claims 34 and 35 over Schulhoff be reconsidered.

A separate fee authorization sheet accompanies this submission. However, for any required fee except for the Issue Fee and the Publication Fee, please charge said fee to Deposit Account No. 50-0310.

Respectfully submitted,



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CLAIMS APPENDIX

CLAIMS 1-35 ON APPEAL:

1. (Previously Presented) An aqueous semiconductor cleaning solution having a pH between about 1.5 and about 6 and comprising:

at least about 75% by weight water;

from about 0.5% to about 10% by weight phosphoric acid;

optionally one or more other acid compounds;

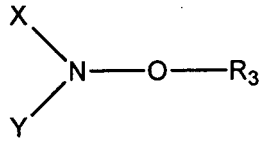
optionally one or more fluoride-containing compounds; and

at least one alkaline compound selected from the group consisting of:

a trialkylammonium hydroxide and/or

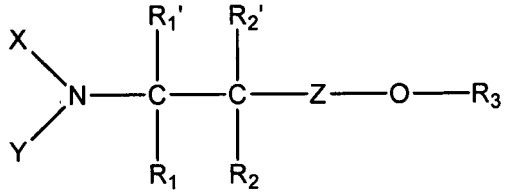
a tetraalkylammonium hydroxide;

a hydroxylamine derivative having the structural formula:



wherein R_3 is hydrogen or a linear, branched, or cyclic hydrocarbon containing from 1 to 7 carbon atoms; and wherein X and Y are, independently, hydrogen or a linear, branched, or cyclic hydrocarbon containing from 1 to 7 carbon atoms, or wherein X and Y are linked together form a nitrogen-containing heterocyclic C_4-C_7 ring;

one or more alkanolamines having the structural formula:



wherein R_1, R_1', R_2, R_2', and R_3 are, independently in each case, hydrogen or a linear, branched, or cyclic hydrocarbon containing from 1 to 7 carbon atoms; wherein Z

is a group having the formula $-(-Q-CR_1R_1'-CR_2R_2'-)_m-$, such that m is a whole number from 0 to 3 (*i.e.*, when m=0, there is no atom between the $-CR_2R_2'-$ group and the $-OR_3$ group in the formula above), R_1, R_1', R_2, and R_2' may be independently defined in each repeat unit, if m>1, within the parameters set forth for these moieties above, and Q may be independently defined in each repeat unit, if m>1, each Q being independently either -O- or $-NR_3-$; and wherein X and Y are, independently in each case, hydrogen, a C_1-C_7 linear, branched, or cyclic hydrocarbon, or a group having the formula $-CR_1R_1'-CR_2R_2'-Z-F$, with F being either $-O-R_3$ or $-NR_3R_4$, where R_4 is defined similarly to R_1, R_1', R_2, R_2', and R_3 above, and with Z, R_1, R_1', R_2, R_2', and R_3 defined as above, or wherein X and Y are linked together form a nitrogen-containing heterocyclic C_4-C_7 ring.

2. (Original) The aqueous semiconductor cleaning solution of claim 1, wherein the pH of the solution is between about 2 and about 6.

3. (Original) The aqueous semiconductor cleaning solution of claim 1, wherein the at least one alkaline component comprises a hydroxlyamine derivative present in an amount from about 0.3% to about 1% by weight.

4. (Original) The aqueous semiconductor cleaning solution of claim 1, wherein the at least one alkaline component comprises hydroxylamine or N,N-diethylhydroxylamine.

5. (Previously Presented) The aqueous semiconductor cleaning solution of claim 1, wherein the at least one alkaline component comprises a tri-alkylammonium hydroxide or tetra-alkylammonium hydroxide present in an amount from about 0.5% to about 3% by weight.

6. (Previously Presented) The aqueous semiconductor cleaning solution of claim 5, wherein the at least one alkaline component comprises choline hydroxide.

7. (Original) The aqueous semiconductor cleaning solution of claim 1, which comprises one or more other acid compounds selected from the group consisting of hydrochloric acid, nitric acid, periodic acid, pyrophosphoric acid, fluorosilicic acid, sulfuric acid, methanesulfonic acid, oxalic acid, lactic acid, citric acid, xylenesulfonic acid, toluenesulfonic acid, formic acid, tartaric acid, propionic acid, benzoic acid, ascorbic acid, gluconic acid, malic acid, malonic acid, succinic acid, gallic acid, butyric acid, trifluoracetic acid, and mixtures thereof.

8. (Previously Presented) The aqueous semiconductor cleaning solution of claim 1, wherein the aqueous semiconductor cleaning solution comprises one or more other acid compounds selected from glycolic acid, methanesulfonic acid, pyrophosphoric acid, oxalic acid, lactic acid, and citric acid.

9. (Previously Presented) The aqueous semiconductor cleaning solution of claim 8, wherein the one or more other acids are present in an amount from about 0.2% to about 5% by weight.

10. (Original) The aqueous semiconductor cleaning solution of claim 1, wherein the aqueous semiconductor cleaning solution comprises one or more fluorine-containing compounds present in an amount from about 0.01% to about 0.1% by weight.

11. (Previously Presented) The aqueous semiconductor cleaning solution of claim 1, wherein the aqueous semiconductor cleaning solution comprises one or more fluorine-containing compounds comprising ammonium bifluoride and/or ammonium fluoride.

12. (Original) The aqueous semiconductor cleaning solution of claim 1, further comprising an organic solvent in an amount from about 5% to about 15% by weight.

13. (Previously Presented) The aqueous semiconductor cleaning solution of claim 12, wherein the organic solvent comprises an organic acid ester.

14. (Original) The aqueous semiconductor cleaning solution of claim 1, further comprising a surfactant.

15. (Previously Presented) The aqueous semiconductor cleaning solution of claim 1, wherein the at least one alkaline compound includes one or more alkanolamines selected from the group consisting of monoethanolamine, 2-(2-hydroxylethylamino)ethanol, 2-(2-aminoethoxy)ethanol, N,N,N-tris(2-hydroxyethyl)-ammonia, isopropanolamine, 3-amino-1-propanol, 2-amino-1-propanol, 2-(N-methylamino)ethanol, 2-(2-aminoethylamino)ethanol, and mixtures thereof.

16. (Previously Presented) The aqueous semiconductor cleaning solution of claim 1, wherein the at least one alkaline compound includes one or more alkanolamines ~~is~~ present in an amount from about 0.5% to about 5% by weight.

17. (Original) The aqueous semiconductor cleaning solution of claim 1, wherein the solution is substantially free from other acid compounds.

18. (Original) The aqueous semiconductor cleaning solution of claim 1, wherein the solution is substantially free from fluoride-containing compounds.

19. (Original) The aqueous semiconductor cleaning solution of claim 1, wherein the solution is substantially free from alkanolamines.

20. (Original) The aqueous semiconductor cleaning solution of claim 1, wherein the solution contains substantially no additional components.

21. (Original) The aqueous semiconductor cleaning solution of claim 1, wherein the solution is substantially free from hydroxylamine derivatives.

22. (Original) The aqueous semiconductor cleaning solution of claim 1, wherein the solution is substantially free from organic solvents.

23. (Original) The aqueous semiconductor cleaning solution of claim 1, wherein the concentration of water is at least about 85% by weight.

24. (Previously Presented) A dilute aqueous semiconductor cleaner and residue remover having a pH between about 1.5 and about 6 and comprising:

a polar solvent selected from water, or a mixture of water and one or more polar organic solvents, present in an amount of at least about 75% by weight;

phosphoric acid or salt thereof, present in an amount from about 0.1% to about 6% by weight of 85% phosphoric acid;

hydroxylamine or a hydroxylamine derivative, present in the solution in an amount from about 0.1% to about 5% by weight not including the counterion of the hydroxylamine derivative salt, if present;

optionally, a tri-alkylammonium hydroxide and/or tetra-alkylammonium hydroxide, present in the solution in an amount from about 0.2% to about 5% by weight;

optionally, an alkanolamine, present in the solution in an amount from about 0.2% to about 5% by weight;

optionally, a fluoride-containing compound, present in the solution in an amount from about 0.001% to about 0.5% by weight;

optionally, an other acid compound, present in the solution in an amount from about 0.05% to about 6% by weight;

optionally, a chelating agent, present in the solution in an amount from about 0.1% to about 8% by weight; and

optionally, a surfactant, present in the solution in an amount from about 0.01% to about 3% by weight.

25. (Previously Presented) The dilute aqueous cleaner and residue remover of claim 24, wherein the cleaner and residue remover consists essentially of: water; about 1.5% to about 2.5% by weight of phosphoric acid; about 0.5% to about 1% by weight of a hydroxylamine or hydroxylamine derivative; and about 0.005% to about 0.04% by weight of a fluoride-containing compound, and wherein the cleaner and residue remover is substantially free from surfactants.

26. (Previously Presented) The dilute aqueous cleaner and residue remover of claim 24, wherein the cleaner and residue remover consists essentially of: about 1.5% to about 2.5% by weight of phosphoric acid; about 0.5% to about 1% by weight of a hydroxylamine derivative; about 0.005% to about 0.04% by weight of a fluoride-containing compound; and about 0.05% to about 0.2% by weight of a surfactant.

27. (Previously Presented) A dilute aqueous cleaner and residue remover consisting essentially of: about 1.5% to about 2.5% by weight of phosphoric acid; about 0.5% to about 1% by weight of a hydroxylamine or hydroxylamine derivative; and about 0.005% to about 0.1% by weight of a fluoride-containing compound.

28. (Original) A dilute aqueous cleaner and residue remover consisting essentially of: about 1.5% to about 2.5% by weight of phosphoric acid; about 0.5% to about 1% by weight of a hydroxylamine derivative; about 0.005% to about 0.1% by weight of a fluoride-containing compound; and about 5% to about 15% by weight of a polar organic solvent.

29. (Previously Presented) A dilute aqueous semiconductor cleaner and residue remover consisting essentially of: 1.5% to about 2.5% by weight of phosphoric acid; and 0.5% to about 1.5% by weight of a tri- alkylammonium salt and/or tetra- alkylammonium salt.

30. (Previously Presented) A dilute aqueous cleaner and residue remover consisting essentially of: about 1.5% to about 4% by weight of 85% phosphoric acid; about 0.3% to about 4% by weight of oxalic acid dihydrate; about 0.3% to about 4% by weight of a monofunctional

organic acid; about 90% to about 99% by weight of water; and optionally between about 0.1% and about 1% of a chelator, wherein the formulation contains substantially no organic solvents and no compounds listed as SARA 3 hazardous compounds on the filing date of this application.

31. (Previously Presented) A dilute aqueous cleaner and residue remover consisting essentially of: about 0.5% to about 6% by weight of 85% phosphoric acid; about 2% to about 12% by weight of oxalic acid dihydrate; optionally about 0.2% to about 15% by weight of a monofunctional organic acid; optionally between about 0.05% and 1.5% by weight of: ammonium hydroxide, an alkyl ammonium hydroxide substituted with 2 or 3 alkyl moieties independently selected from methyl and ethyl moieties, or a mixture thereof; optionally between about 0.1% and about 1% of a chelator; and water, wherein the pH of the cleaner and residue remover is between 1.5 and 9, and the cleaner and residue remove contains substantially no organic solvents and no compounds listed as SARA 3 hazardous compounds on the filing date of this application.

32. (Previously Presented) A dilute aqueous cleaner and residue remover consisting essentially of: about 1.5% to about 4% by weight of 85% phosphoric acid; about 1% to about 4% by weight of glycolic acid; and about 92% to about 97.5% by weight of water.

33. (Previously Presented) The semiconductor cleaning solution of claim 32, wherein the solution is substantially free from: alkanolamines, quaternary ammonium compounds, hydroxylamine and hydroxylamine derivatives, other acid compounds, fluoride-containing compounds, organic solvents, non-hydroxyl-containing amines, chelating agents, and surfactants.

34. (Previously Presented) A dilute aqueous cleaner and residue remover consisting essentially of: about 3% to about 6% by weight of 85% phosphoric acid; about 1% to about 2% by weight of glycolic acid; and about 92% to about 96% by weight of water.

35. (Previously Presented) The semiconductor cleaning solution of claim 34, wherein the solution is substantially free from: alkanolamines, quaternary ammonium compounds,

hydroxylamine and hydroxylamine derivatives, other acid compounds, fluoride-containing compounds, organic solvents, non-hydroxyl-containing amines, chelating agents, and surfactants.

EVIDENCE APPENDIX:

NOT APPLICABLE.

Pursuant to 37 C.F.R. § 41.37(c)(1)(ix), submitted herewith are copies of any evidence submitted pursuant to 37 C.F.R. §§ 1.130, 1.131, or 1.132 or any other evidence entered by the Examiner and relied upon by Appellant in the appeal.

These documents have been submitted on [Press F11/Identify evidence submitted and give date] date.

RELATED PROCEEDINGS APPENDIX

NOT APPLICABLE

Submitted herewith are copies of decisions rendered by a court or the Board in any proceeding identified about in Section II pursuant to 37 C.F.R. § 41.37(c)(1)(ii).